

## ARTICLE

# Complications of percutaneous therapy

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### Abstract

Percutaneous tumour ablation is a minimally invasive, image guided procedure which attracts a low morbidity (2%–10%) and procedure-related deaths are exceptional. As such it can be offered to patients who could not withstand more invasive procedures such as surgical resection. Complications can be divided into systemic and local, those related to the anatomical area and those specific to the ablative technique or the particular tumour type. Most ablation experience has been gained using radiofrequency in the liver for metastases or hepatocellular carcinoma. Newer applications include ablation of inoperable lung primary or metastatic disease and renal cell carcinoma. The most common complications are haemorrhage, super-added infection or collateral damage. Tumour dissemination, whilst a theoretical risk, is very unusual.

**Keywords:** Radiofrequency ablation; interstitial laser therapy; image guided intervention.

## Thermal ablation

### *General principles*

Percutaneous, image guided therapies are for the most part minimally invasive techniques resulting in little systemic disturbance. The major complication rates are low and procedure-related deaths exceptional. Most experience with thermal ablation has been gained in the liver and there are several large published series with major complication rates of between 2.2% and 10% [1–3]. The mortality rates in these series were 0.09%–1.4%. The very low morbidity is one of the main attractions of image guided therapy. Many patients prefer a single intervention to the long-term, ongoing morbidity associated with courses of chemotherapy and there is no comparison between a major surgical procedure such as liver resection and ablation. Liver resection still attracts a mortality of up to 3% and a major morbidity of 26% and this in patients who have been carefully selected as being able to withstand major surgery.

Some of the best results in ablation are for patients with low volume disease who had they been sufficiently fit would have been surgical candidates. In a subgroup

of 34 patients with colorectal liver metastases treated at our institution who had small solitary tumours (median diameter 2.5 cm, range 1–4 cm) the 5-year survival was 53%. It is very important that patients who cannot undergo resection but who could undergo a minimally invasive technique are not denied the opportunity of a locally destructive therapy combined whenever possible with systemic chemotherapy.

### *Liver ablation*

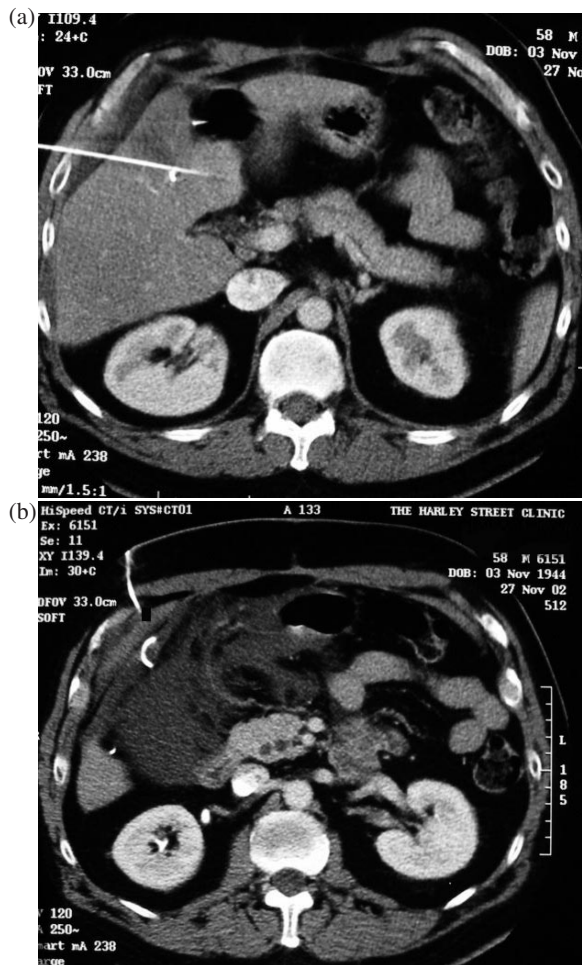
#### *Expected abnormalities*

In any patient with a substantial volume of ablation-induced necrosis, a syndrome of malaise, myalgia and low grade fever is to be expected. Similarly, destruction of liver parenchyma produces very high levels of serum transaminases which can go up by as much as tenfold in the immediate days post procedure. If CT scans are performed at this time, small amounts of fluid are often seen around the liver and at the lung base.

Complications can be divided into local and systemic, those that are related to the needle or electrode insertion

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and those related to thermal injury, those that are individual to a given technique and those that are related to a particular tumour biology.



**Figure 1** Five percent dextrose isolation to prevent collateral damage during thermal ablation. (a) Needle electrode positioned for treatment of a liver metastasis. Note the proximity of the stomach to the electrode. (b) One litre of dextrose has been instilled through a 5Fr catheter between the liver and the stomach, successfully displacing the stomach away from the ablation zone.

#### Local complications

Haemorrhage is rarely a problem in patients with normal liver parenchyma. Acute haemorrhage sufficient to cause a haemodynamic disturbance is not a feature and if bleeding does occur it is usually a slow loss of relatively small (<2 units) quantities of blood over several hours. Occasionally it is necessary to administer a blood transfusion in the days following the procedure, embolisation is exceptionally rare and surgical intervention unheard of. Bleeding can be problematic in cirrhotic patients with abnormal coagulation and low platelet counts. As a result the volume of tumour that can be safely ablated is more restricted in HCC as compared with patients who

have metastatic disease on the background of normal liver parenchyma. Typical ablation criteria for HCC are solitary tumours <5 cm or <3 HCC nodules <3 cm in diameter, whereas in metastatic disease patients with five or fewer tumours <5 cm in diameter or as many as nine metastases up to 4 cm in diameter can be treated. Intra-procedural monitoring permits interruption of the procedure should haemorrhage occur.

#### Collateral damage

Needle stick injury to adjacent structures may cause perforation or pneumothorax but in general electrode insertion is not a major problem. Thermal injury can be. It is possible to damage adjacent stomach, small or large bowel resulting in perforation, fistula formation and abscesses. In the last few years we have avoided injury to bowel, diaphragm, gall bladder, stomach, etc. by instilling 500–1000 ml of 5% dextrose between the area of ablation and the vulnerable structure (Fig. 1). The 5% dextrose both displaces the adjacent viscera and effectively insulates the liver. A similar technique can be used to protect the gall bladder. Injury to the bile duct is harder to avoid and treatment adjacent to major bile ducts should be avoided or the duct should be cannulated and cooled. It is possible to thrombose or occlude portal vein branches or hepatic veins. The possibility of thrombosis is increased if ablation is performed during clamping of the vascular pedicle at surgery. This is particularly critical in cirrhotic patients where fatalities have occurred following portal venous thrombosis.

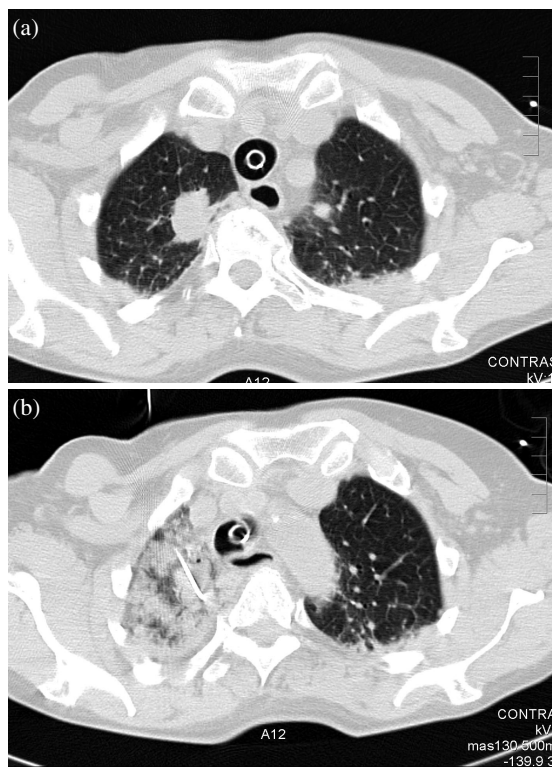
#### Infection

Secondary infection in the ablated zone usually arises as a delayed complication from a septic focus elsewhere in the body. The other major aetiological factor is the presence of a communication between the biliary system and the gut via a stent or bilio-enteric anastomosis. Some centres decline to treat these patients. If they are treated then they should receive 3 months of rotating antibiotics post procedure. The presence of gas or enlargement of the ablation zone can indicate infection. A low threshold for needle aspiration of any suspected infection will result in early diagnosis and a better outcome. If an ablation zone becomes infected then percutaneous drainage and IV antibiotics are usually effective.

#### Risk of dissemination

The incidence of seeding in large multi-centre series is very low, of the order of 0.5% [4–6]. The chance of seeding can be reduced by careful technique, e.g. heating a needle prior to removal so that any adherent viable tumour cells are destroyed. If seeding does occur then resection +/- local radiotherapy are usually effective. There are three case reports in the literature of tumour dissemination via the portal vein or biliary

tract in patients with hepatocellular carcinoma. Although seeding and dissemination can occur, the risk has been greatly overemphasized. In the surgical literature seeding is associated with a poor prognosis but if isolated, adequately diagnosed and treated, tract seeding does not necessarily have a poor prognosis.



**Figure 2** Radiofrequency ablation to pulmonary metastases. (a) Axial CT section shows pulmonary metastases, one in each apex. (b) Following electrode insertion, CT scans show abrupt rapid opacification of the lung parenchyma around the metastasis presumably secondary to haemorrhage. The procedure was discontinued but the patient remained asymptomatic with no associated haemodynamic disturbance and no intervention or transfusion was required.

#### *Tumour dependent complications*

An important part of the work up for HCC is an assessment of the severity of the underlying liver disease. Most centres will only perform ablation in Childs Pugh Class A and B patients. Ablation in Childs Pugh C can result in delayed (3 weeks post procedure) variceal haemorrhage. Hepatic decompensation can occur following the ablation procedures and whereas in lower grade Childs Pugh patients (score <8) this is temporary, in those with higher grades, this deterioration may be permanent.

Ablation of metastases from secretory neuroendocrine tumours can be associated with hormone release and dramatic, rapid swings in blood pressure. For severely symptomatic patients there is a very real risk of a

carcinoid crisis which can be fatal. Peri-procedural treatment with Octreotide is required with careful monitoring of the patient both during and after the ablation.

#### *Lung ablation*

Interestingly despite the needle size (14–17 G) and the long dwell time of ablation procedures, the complication rate is no more than for biopsy patients<sup>[7]</sup>. The incidence of pneumothorax is approximately 40%, and of these only 25% require drainage. Pleural effusion occurs in 25%. A particularly concerning but rare complication is life threatening or fatal haemorrhage into the pulmonary parenchyma (Fig. 2). Secondary infection is another important but rare complication. Cavitation occurs in as many as 24% of healing ablated lesions and does not necessarily indicate infection.

#### *Renal ablation*

This technique carries a similar complication profile to liver ablation. Care must be taken to avoid damage to the proximal ureter. Ablation is often applied to patients with solitary kidneys or multiple renal cell tumours, e.g. patients with von Hippel Lindau disease for whom preservation of renal function is critical. Importantly ablation is not associated with a deterioration in function.

#### *Technique based complications*

There are some specific complications related to the heating technique, e.g. it is possible for pacing wires to carry the RF current resulting in damage to the electronic control box. In patients with pacemakers an attempt should be made to direct the RF current between the electrode and the grounding pad without crossing the chest. After the ablation, pacemakers need to be checked and reset. The manufacturers state that patients with pacemakers should not undergo ablation and there are reports of irreparable damage to the pacemaker. In part, the decision to treat or not depends on how pacemaker dependent the patient is.

#### *Miscellaneous*

1. Adrenal ablation of metastases can result in severe hypertension, presumably due to catecholamine release from normal functioning adrenal tissue. Intra-arterial BP monitoring is recommended.
2. Hyperkalaemia has been reported in a patient with renal failure. Most likely hyperkalaemia developed secondary to release of intra-cellular potassium from the ablated cells and whereas this can be dealt with in patients

with normal renal function, dangerously high potassium levels were seen in this patient with renal failure.

3. Myelin is very vulnerable to heating and the subsequent neural damage is often irreversible. Treatment in close proximity to nerves should be avoided. Some centres advocate positioning a thermocouple between the ablation zone and the vulnerable neural structure so that ablation can be discontinued if the temperature rises.

### *Percutaneous injection therapies*

The most widely practiced injection therapy is percutaneous ethanol injection for the ablation of HCC. RF has replaced PEI in many centres but PEI is still practiced as a low cost alternative in some parts of the world. PEI is usually performed with ultrasound guidance under conscious sedation often on an outpatient basis. It carries a lower complication rate than RF and can be used, e.g. in exophytic HCC, which carries the risk of rupture during RF ablation. Extravasation of ethanol onto the peritoneal surface is exquisitely painful, ethanol injection into a bile duct can result in biliary strictures.

### **Conclusion**

There is a wide range of potential complications, many of which can be avoided with good pre-ablation

assessment, planning and careful technique. Some of the complications which occurred early in the practice of ablation can now be avoided. Early detection of any complications that do occur also reduces morbidity. The low morbidity of this technique is a particularly attractive feature.

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